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Nakamura et al.

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(54) **SOCKET AND ELECTRONIC DEVICE TEST APPARATUS**

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CPC ***G01R 1/0433*** (2013.01); ***G01R 1/0466*** (2013.01); ***G01R 1/0483*** (2013.01); ***G01R 31/2601*** (2013.01); *G01R 1/0735* (2013.01); *G01R 31/2886* (2013.01)

(58) **Field of Classification Search**
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USPC 324/754.01–754.3, 756.01–756.07
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,757,199 A 5/1998 Maruyama
5,975,915 A * 11/1999 Yamazaki G01R 1/0433 439/331

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1181528 12/2004
CN 1612321 5/2005

(Continued)

OTHER PUBLICATIONS

Korean Office action, mail date is Aug. 28, 2013.

(Continued)

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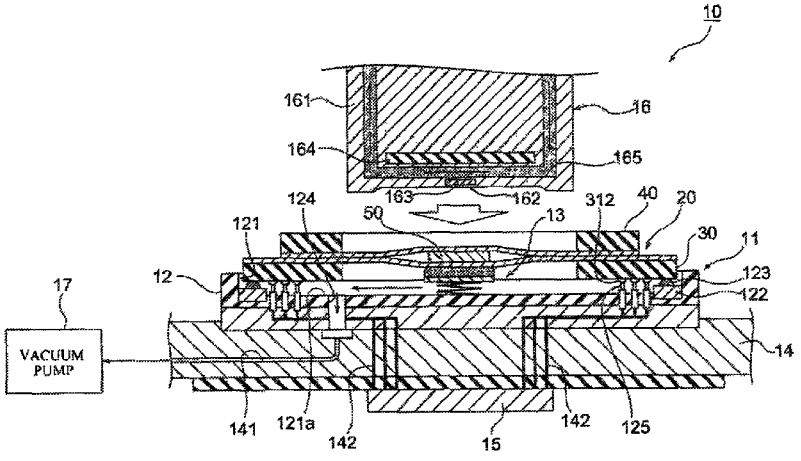
(57) **ABSTRACT**

A socket is electrically connected to a test carrier. The test carrier includes a film-shaped first member on which at least one internal terminal, which contacts at least one electrode of an electronic device, is provided; and at least one external terminal which is electrically connected to the internal terminal. The socket includes: at least one contactor which contacts the external terminal; and a first pusher which pushes a portion of the first member where the internal terminal is provided and a portion of the first member surrounding the internal terminal. The first pusher includes: a bag member which has a sealed space within the bag member; and a fluid which is housed in the sealed space.

4 Claims, 12 Drawing Sheets



(51) **Int. Cl.**

G01R 31/26	(2014.01)
G01R 1/073	(2006.01)
G01R 31/28	(2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,062,873	A	5/2000	Kato	
6,563,330	B1	5/2003	Maruyama et al.	
6,774,650	B2	8/2004	Maruyama et al.	
7,235,413	B2	6/2007	Hasebe et al.	
7,601,018	B2 *	10/2009	Hwang	G01R 1/0483 439/331
2003/0160626	A1	8/2003	Maruyama et al.	
2005/0093565	A1	5/2005	Okamoto et al.	
2005/0095734	A1	5/2005	Hasebe et al.	
2007/0207559	A1	9/2007	Hasebe et al.	
2008/0020498	A1	1/2008	Okamoto et al.	
2010/0304510	A1	12/2010	Okamoto et al.	
2011/0136272	A1	6/2011	Okamoto et al.	
2011/0175634	A1	7/2011	Okamoto et al.	

FOREIGN PATENT DOCUMENTS

JP	07-034590	8/1995
JP	7-263504	10/1995
JP	2005-249448	9/2005

OTHER PUBLICATIONS

Korea Office action, mail date is Jan. 13, 2014.
China Office action, mail date is Aug. 20, 2014.

* cited by examiner

FIG.1

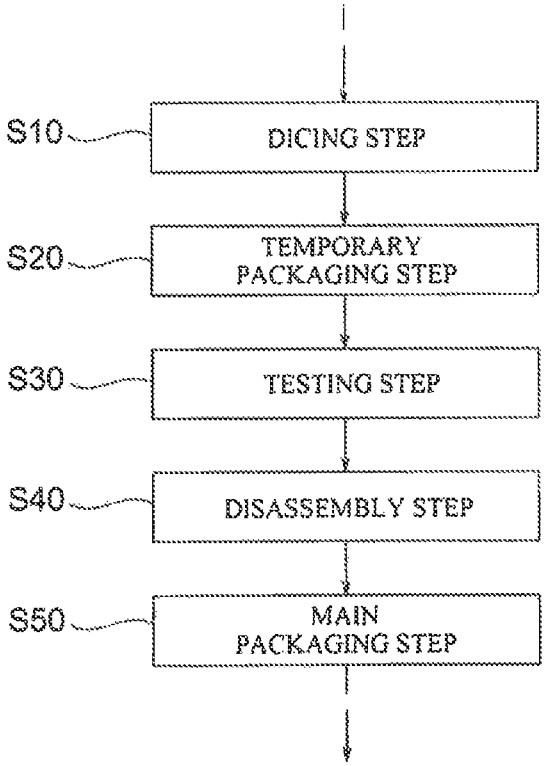

S10
DICING STEP
S20
TEMPORARY PACKAGING STEP
S30
TESTING STEP
S40
DISASSEMBLY STEP
S50
MAIN PACKAGING STEP

FIG.2

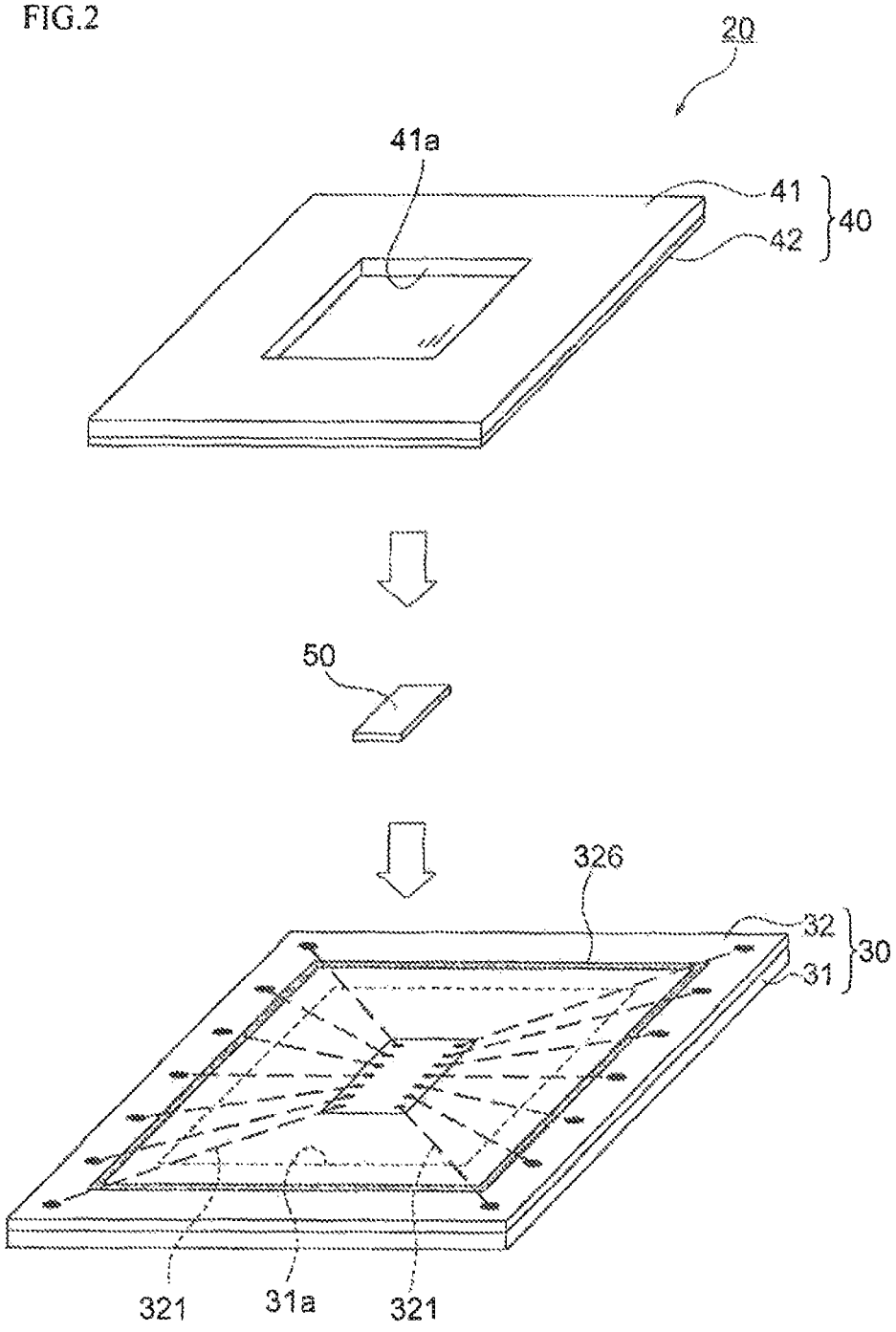
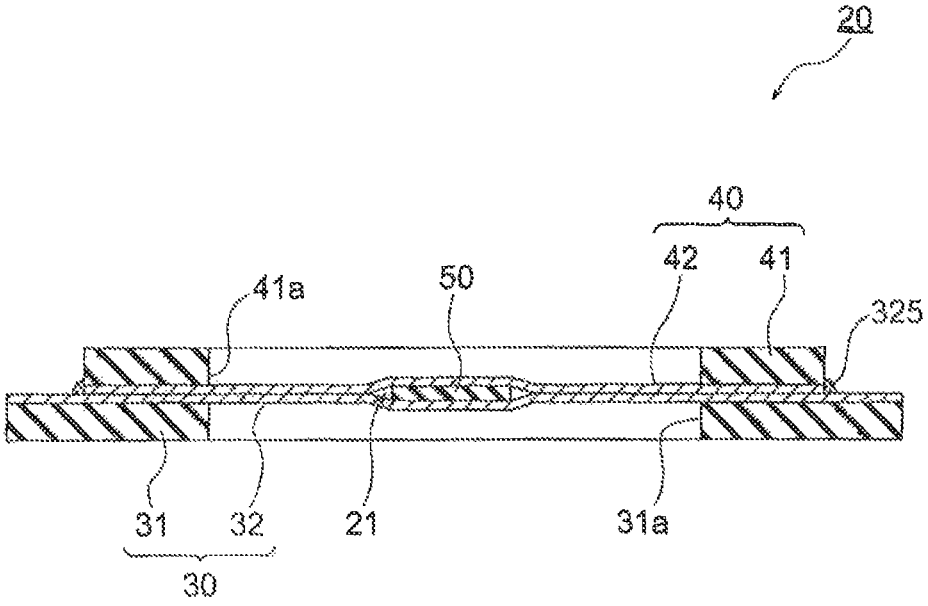


FIG.3



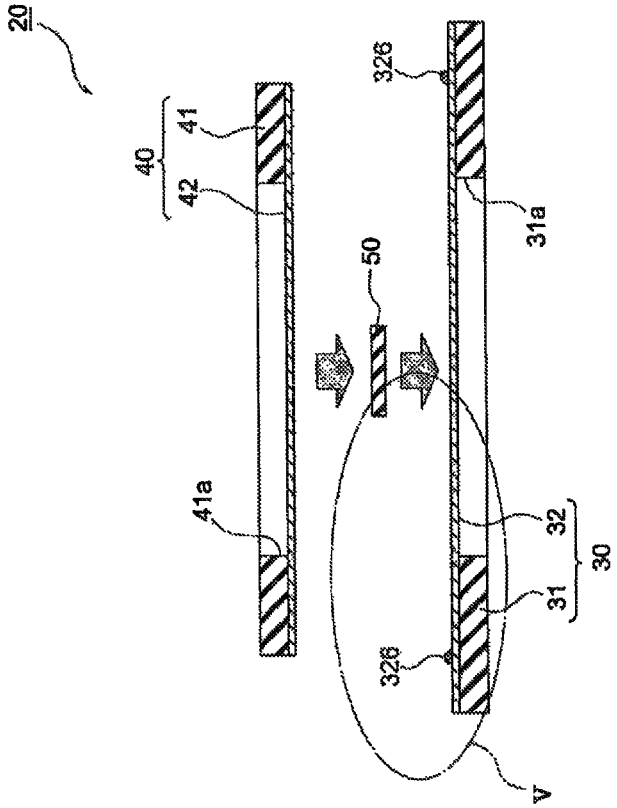


FIG.4

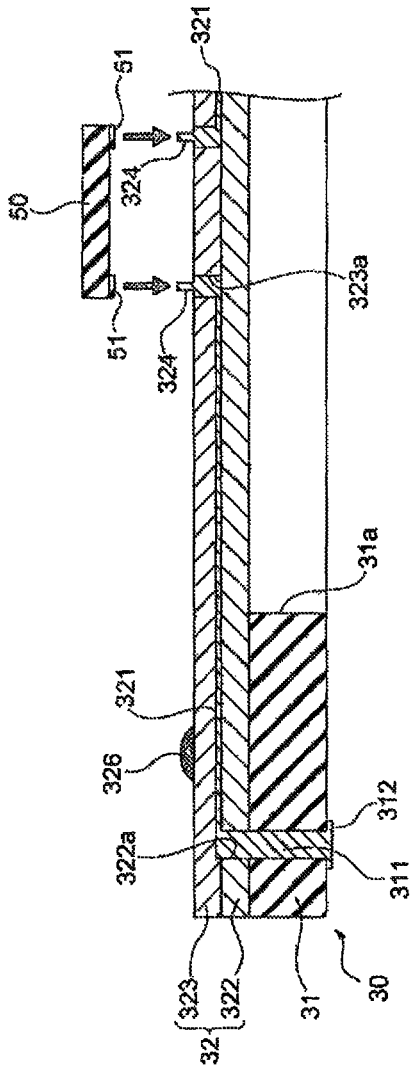

321
51
50
324
323a
51
324
31a
321
326
312
322a
311
323
322
32
31
30

FIG.5

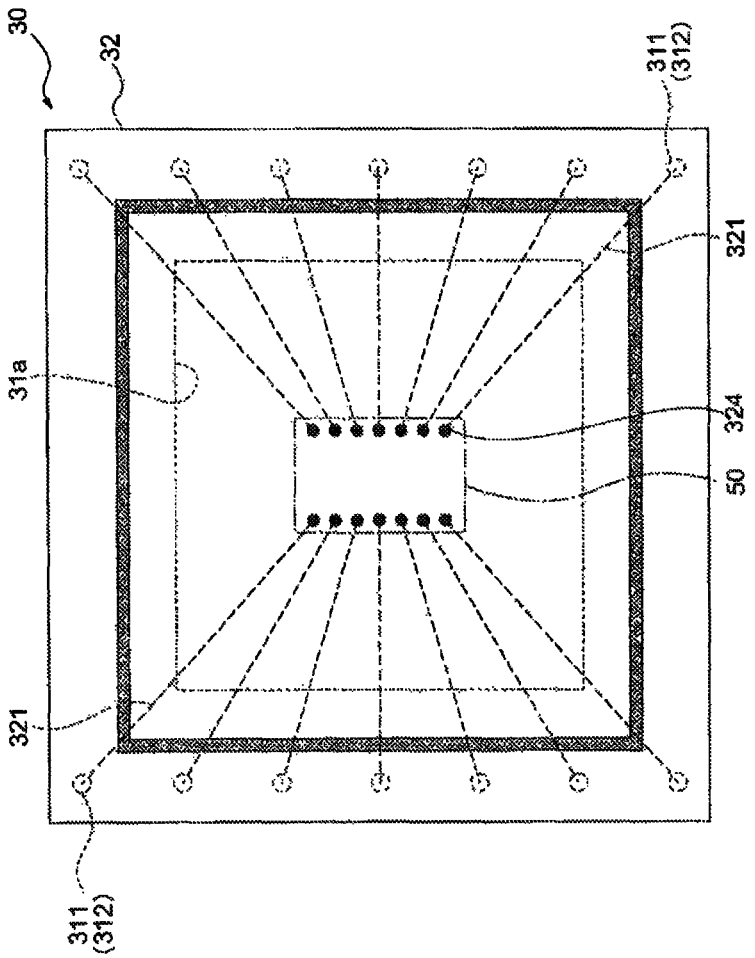


FIG.6

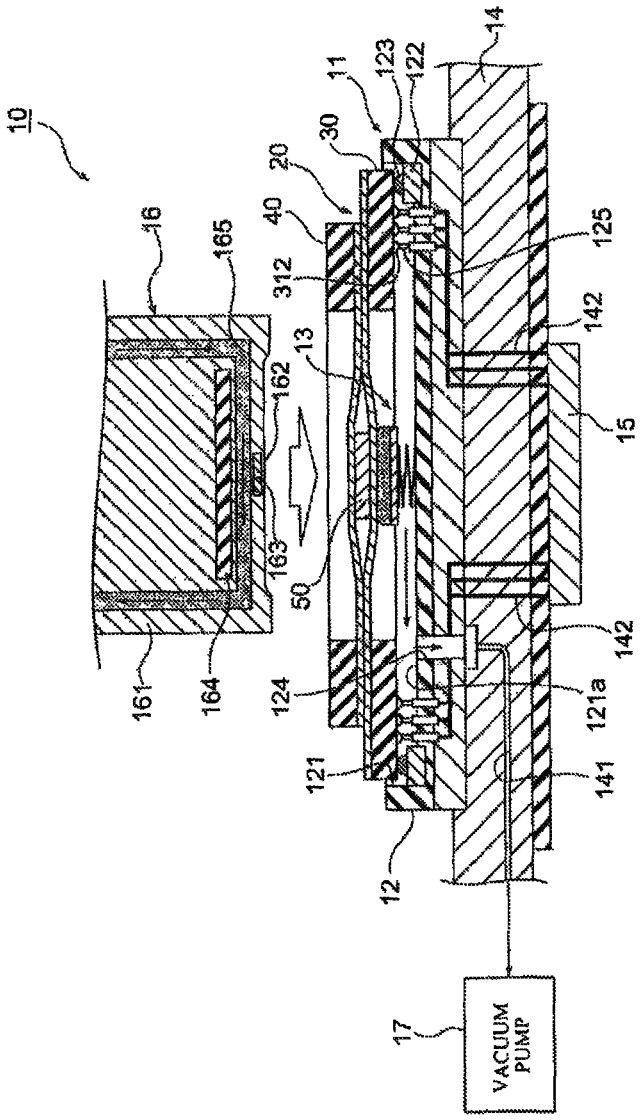

10
16
165
40
20
30
11
123
122
14
312
125
142
13
162
15
163
50
142
161
164
124
121a
121
141
12
17
VACUUM PUMP

FIG.7

FIG.8

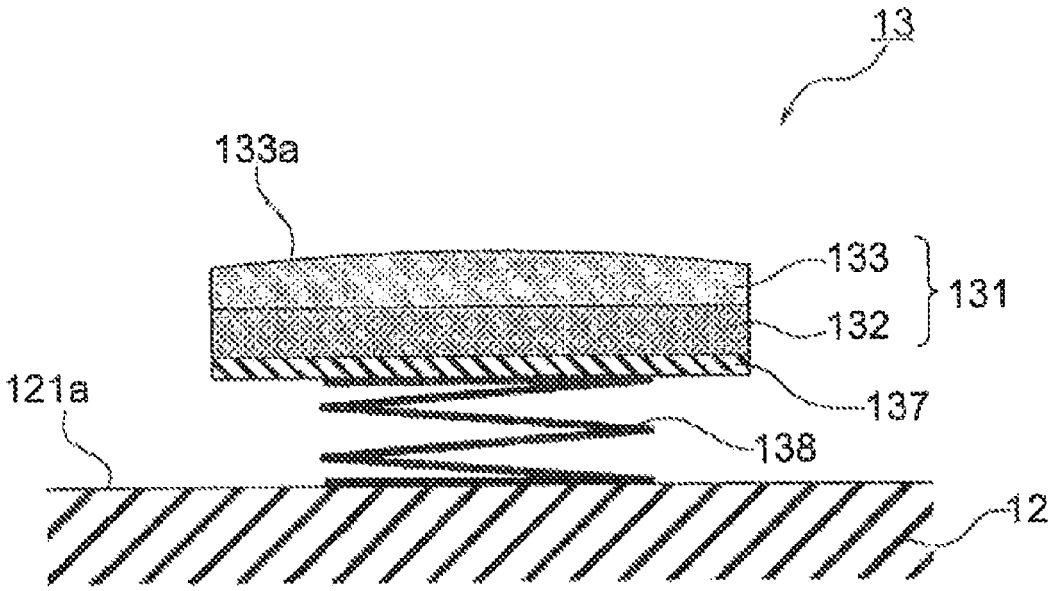


FIG.9

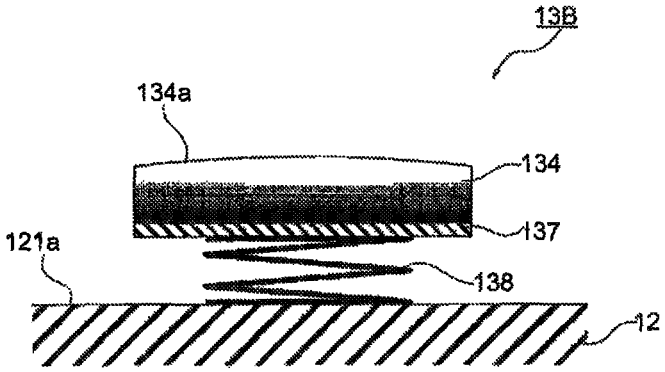
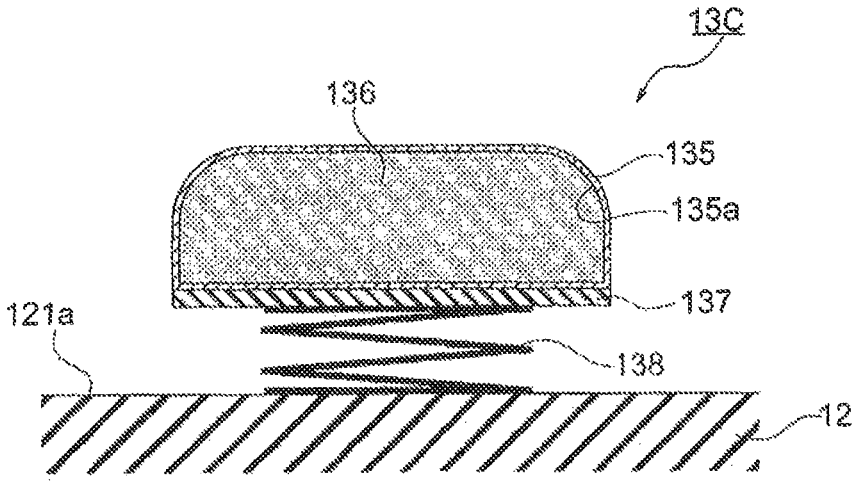


FIG.10



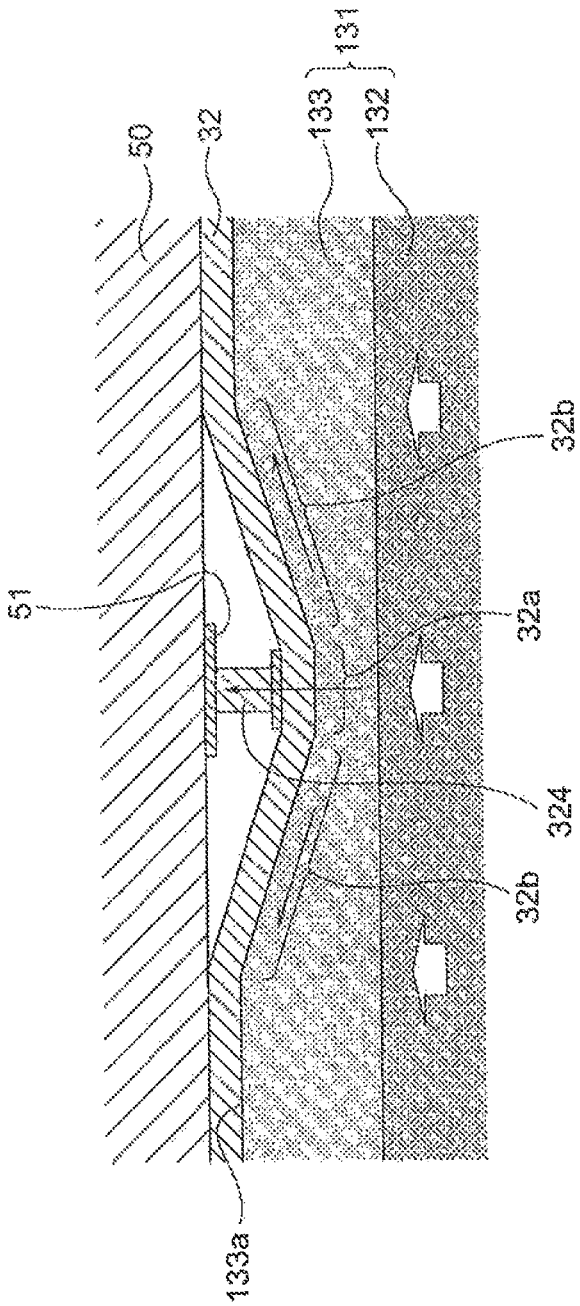


FIG.11

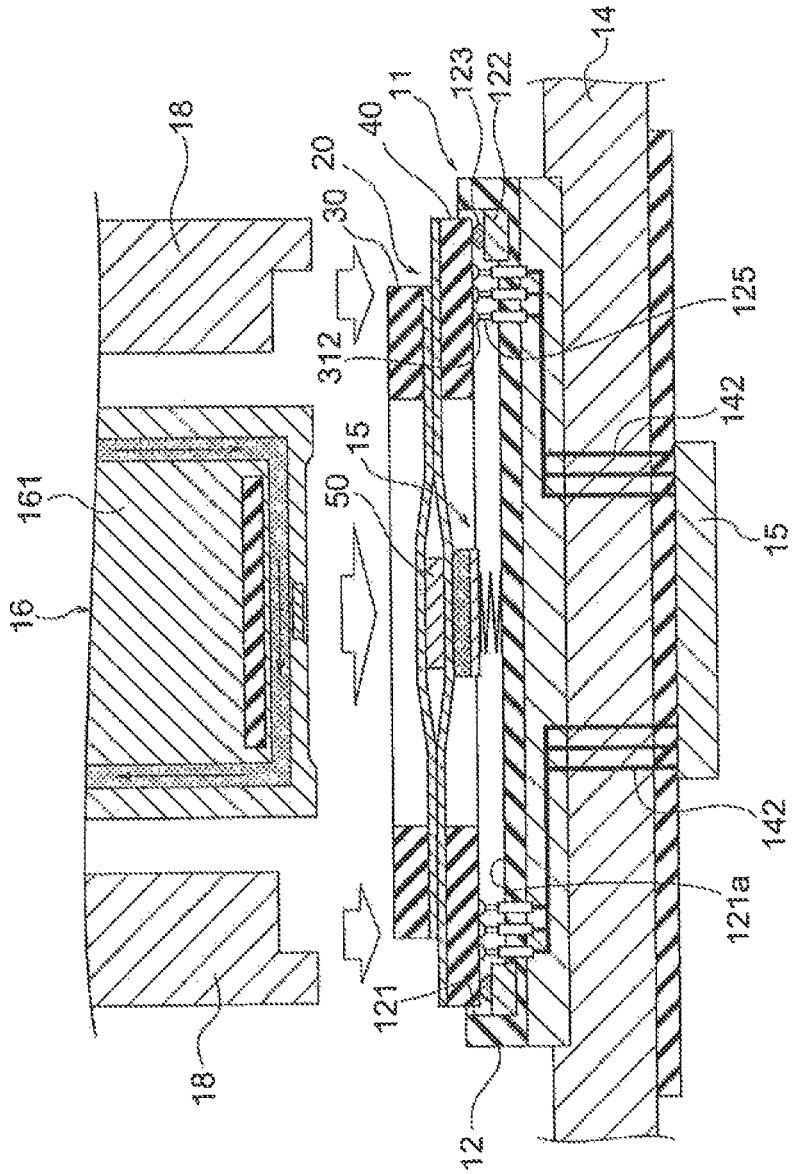

14
123
122
11
40
20
30
18
312
125
142
15
50
161
16
15
142
121a
121
18
12

FIG.12

SOCKET AND ELECTRONIC DEVICE TEST APPARATUS

This application is a divisional application of U.S. patent application Ser. No. 13/644,197, filed Oct. 3, 2012, now U.S. Pat. No. 8,988,095 which is based on and claims priority of Japanese Patent Application No. 2011-219943 filed on Oct. 4, 2011, the disclosures of which are expressly incorporated by reference herein.

TECHNICAL FIELD

The present invention relates to a socket to which a test carrier, in which a die chip or other electronic device in which an integrated circuit or other electronic circuit is formed is temporarily mounted, is electrically connected and to an electronic device test apparatus which comprises that socket.

BACKGROUND ART

Known in the art is a test carrier which comprises a contact sheet having a thickness 0.05 to 0.1 mm or so film made of polyimide on which contact pads and interconnect patterns are formed. The contact pads correspond to electrode patterns of a chip under test and the interconnect patterns are connected to the contact pads and secure contact with an external test apparatus (for example, see PLT 1).

CITATIONS LIST

Patent Literature

PLT 1: Japanese Patent Publication No. 7-263504 A1

SUMMARY OF INVENTION

Technical Problem

If the density of the contact pads or interconnect patterns becomes higher, sometimes the stress at the time of formation of the interconnects causes slight waviness to the thin film of the contact sheet. If waviness occurs in the film of the contact sheet, a spot where the contact pad is not electrically connected with the electrode of the chip will arise and there is the problem that contact defects will sometimes occur.

The technical problem of the present invention is the provision of a socket and an electronic test apparatus which can suppress the occurrence of contact defects.

Solution to Problem

[1] socket according to the present invention is a socket to which a test carrier is electrically connected, the test carrier which has: a film-shaped first member on which at least one internal terminal which contacts at least one electrode of an electronic device is formed; and at least one external terminal which is electrically connected to the internal terminal, the socket comprising: at least one contactor which contacts the external terminal; and a first pusher which pushes a portion of the first member where the internal terminal is formed and a portion of the first member surrounding the internal terminal, wherein the first pusher has: a first elastic member; and a second elastic member which is softer than the first elastic member, is laid over the first elastic member, and contacts the first member.

[2] In the invention, the second elastic member may have a front surface which has a projecting shape which gradually becomes higher with distance to a center of the projecting shape.

[3] A socket according to the present invention is a socket to which a test carrier is electrically connected, the test carrier which has: a film-shaped first member on which at least one internal terminal which contacts at least one electrode of an electronic device is formed; and at least one external terminal which is electrically connected to the internal terminal, the socket comprising: at least one contactor which contacts the external terminal; and a first pusher which pushes a portion part of the first member where the internal terminal is formed and a portion of the first member surrounding the internal terminal, wherein the first pusher has an elastic member which becomes softer in stages or gradually with distance to the first member.

[4] In the invention, the elastic member may have a front surface which has a projecting shape which gradually becomes higher with distance to a center of the projecting shape.

[5] A socket according to the present invention is a socket to which a test carrier is electrically connected, the test carrier which has: a film-shaped first member on which at least one internal terminal which contacts at least one electrode of an electronic device is formed and at least one external terminal which is electrically connected to the internal terminal, the socket comprising: at least one contactor which contacts the external terminal; and a first pusher which pushes a portion of the first member where the internal terminal is formed and a portion of the first member surrounding the internal terminal, wherein the first pusher has: a bag member which has a sealed space inside it; and a fluid which is housed in the sealed space.

[6] An electronic device test apparatus according to the present invention is an electronic device test apparatus which tests an electronic device which is temporarily mounted to the test carrier, the electronic device test apparatus comprising: the above socket; a contacting device which brings the external terminal and the contactor into contact; and a second pusher which pushes the test carrier from a direction opposite to the pushing direction of the first pusher.

[7] In the invention, the second pusher may also push a second member of the test carrier which holds the electronic device with a first member.

[8] In the invention, the electronic device may also be a die which is diced from a semiconductor wafer.

Advantageous Effects of Invention

In the present invention, a first pusher which has a plurality of types of flexibility is used to push a portion of the first member where internal terminal is formed and to push a portion of the first member around the internal terminal. For this reason, it is possible to push and extend the film-shaped first member to eliminate waviness while making the internal terminal of the test carrier contacts the electrode of the electronic device, so it is possible to suppress contact defects between electrodes and internal terminals.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a flow chart which shows part of a device production process in an embodiment of the present invention.

FIG. **2** is a disassembled perspective view of a test carrier in an embodiment of the present invention.

FIG. **3** is a cross-sectional view of a test carrier in an embodiment of the present invention.

FIG. **4** is a disassembled cross-sectional view of a test carrier in an embodiment of the present invention.

FIG. **5** is an enlarged view of a part V of FIG. **4**.

FIG. **6** is a plan view which shows a base member of a test carrier in an embodiment of the present invention.

FIG. **7** is a cross-sectional view which shows the configuration of an electronic device test apparatus in an embodiment of the present invention.

FIG. **8** is a cross-sectional view which shows the configuration of a pushing mechanism in an embodiment of the present invention.

FIG. **9** is a cross-sectional view which shows a first modification of the pushing mechanism in an embodiment of the present invention.

FIG. **10** is a cross-sectional view which shows a second modification of the pushing mechanism in an embodiment of the present invention.

FIG. **11** is a cross-sectional view which shows a base film of a test carrier which is pushed by the pushing mechanism which is shown in FIG. **8**.

FIG. **12** is a cross-sectional view which shows a modification of an electronic device test apparatus in an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

Below, a first embodiment of the present invention will be explained based on the drawings.

FIG. **1** is a flow chart which shows part of a device production process in the present embodiment.

In the present embodiment, after a semiconductor wafer is diced (after step S**10** of FIG. **1**) and before the final packaging (before step S**50**), the electronic circuits which are built into a die **50** are tested (step S**20** to S**40**).

In the present embodiment, first, a carrier assembly apparatus (not shown) is used to temporarily mount the die **50** into a test carrier **20** (step S**20**). Next, through this test carrier **20**, the die **50** and the test circuit **15** of the electronic device test apparatus **10** (see FIG. **7**) are electrically connected and the electronic circuits which are built into the die **50** are tested (step S**30**). Further, after this test, the die **50** is taken out from the test carrier **20** (step S**40**), then the die **50** is packaged whereby the device is completed as a final product (step S**50**).

First, the configuration of the test carrier **20** into which the die **50** is temporarily mounted (provisionally packaged) for the test in the present embodiment will be explained while referring to FIG. **2** to FIG. **6**.

FIG. **2** to FIG. **5** are views which show as test carrier in the present embodiment, while FIG. **6** is a plan view which shows as base member of the test carrier.

A test carrier **20** in the present embodiment, as shown in FIG. **2** to FIG. **4**, comprises: a base member **30** on which a die **50** is placed; and a cover member **40** which is covered over the base member **30**. This test carrier **20** holds the die **50** by having the die **50** interposed between the base member **30** and the cover member **40** in a state reduced in pressure from atmospheric pressure.

The base member **30** comprises a base frame **31** and a base film **32**. Note that, the base film **32** in the present embodiment is equivalent to one example of the first member in the present invention.

The base frame **31** is a rigid board which has a high rigidity (at least a rigidity higher than the base film **32** or the cover film **42**) and is formed with an opening **31***a* at its center. As the material which forms this base frame **31**, for example, a polyamide imide resin, ceramic, glass, etc. may be mentioned.

On the other hand, the base film **32** is a film which has flexibility. It is attached to the entire surface of the base frame **31**, including the center opening **31***a*, through a binder (not shown). In this way, in the present embodiment, a base frame **31** with a high rigidity is attached to the base film **32** which has flexibility, so the handling ability of the base member **30** is improved. Note that, it is also possible to omit the base frame **31** and form the base member **30** by only the base film **32**.

As shown in FIG. **5**, this base film **32** has: a base layer **322** on which interconnect patterns **321** are formed; and a cover layer **323** which covers this base layer **322** through an adhesive layer (not shown). Both of the base layer **322** and the cover layer **323** of the base film **32** comprise, for example, polyimide films. The interconnect patterns **321** are, for example, formed by etching copper foil which is laminated on the base layer **322**. Note that, the cover layer **323** may also be omitted and the interconnect patterns **321** may be exposed on the base film **30**.

As shown in FIG. **5** and FIG. **6**, one end of each interconnect pattern **321** is exposed through an opening **323***a* which is formed in the cover layer **323**. A bump **324** to which an electrode pad **41** of the die **50** is to be connected is formed on it. The bump **324** is, for example, composed of copper (Cu), nickel (Ni), etc. For example, the semi-additive method is used to form it on the end part of the interconnect pattern **321**. This bump **324** is arranged so as to correspond to an electrode pad **41** of the die **50**.

On the other hand, the position on the base frame **31** corresponding to the other end of the interconnect pattern **321** has a through hole **311** passing through it. The interconnect pattern **321** is connected through an opening **322***a* which is formed in the base layer **322** to the through hole **311**. This through hole **311** is connected to an external terminal **312** which is formed on the bottom surface of the base frame **31**. This external terminal **33** is contacted by a later explained contactor **125** of a electronic device test apparatus **10** when testing the electronic circuit which is built into the die **50**.

Incidentally, FIG. **5** only shows two electrode pads **51**, but in actuality, the die **50** is formed with a large number of electrode pads **51** at a narrow pitch. On the base film **32** as well, a large number of bumps **324** are arranged at a narrow pitch so as to correspond to the electrode pads **51**. The bump **324** in the present embodiment is equivalent to one example of an internal terminal in the present invention. The die **50** in the present embodiment is equivalent to one example of an electronic device in the present invention, while the electrode pad **51** in the present embodiment is equivalent to one example of an electrode of the present invention.

Note that, the interconnect patterns **321** are not limited to the above configurations. For example, while not particularly shown, part of the interconnect patterns **321** may also be formed in real time by ink jet printing on the front surface of the base film **32**. Alternatively, all of the interconnect patterns **321** may be formed by ink jet printing.

Further, the other ends of the interconnect patterns **321** may be positioned at the inside of the center opening **31***a* of the base frame **31** so as to form the external terminals **312** on the back surface of the base film **32**. Alternatively, the other ends of the interconnect patterns **321** may be exposed on the top sides and external terminals **312** may be formed on the top surface of the base film **32**.

As shown in FIG. **2** to FIG. **4**, the cover member **40** comprises a cover frame **41** and a cover film **42**. The cover film **42** in the present embodiment is equivalent to one example of the second member of the present invention.

The cover frame **41** is a rigid board which has a high rigidity (at least a rigidity higher than the base film **32** or the cover film **42**) and is formed with an opening **41***a* at its center. In the present embodiment, this cover frame **41**, in the same way as the above-mentioned base frame **31**, is for example composed of a polyamide imide resin, ceramic, glass, etc.

On the other hand, the cover film **42** is a film which has flexibility and is attached to the entire surface of the cover frame **41**, including the center opening **41***a*, through a binder (not shown). In the present embodiment, since the cover frame **41** with a high rigidity is attached to the cover film **42** which has flexibility, the handling ability of the cover member **40** is improved. Note that, the cover member **40** may also comprise only the cover film **42**. Alternatively, the cover member **40** may also comprise only a rigid board which is not formed with the opening **41***a*.

Further, for example when both the top and bottom surfaces of the die **50** are formed with electrode pads **51**, in addition to the base member **30**, the cover member **40** can also be formed with interconnect patterns. In this case, by the same procedure with the above-mentioned base frame **31** and base film **32**, the cover frame **41** is formed with external terminals and through holes and the cover film **42** is formed with interconnect patterns or bumps.

The above explained test carrier **20** is assembled as explained next.

That is, first, in the state where the electrode pads **51** are aligned with the bumps **324**, the die **50** is placed on the base member **30**.

Next, under an environment which is reduced in pressure compared with atmospheric pressure, the cover member **40** is laid over the base member **30** and the die **50** is interposed between the base member **30** and the cover member **40**. At this time, the base film **32** of the base member **30** and the cover film **42** of the cover member **40** are made to directly contact each other by the cover member **40** being laid on the base member **30**.

Next, still in the state with the die **50** interposed between the base member **30** and the cover member **50**, the test carrier **20** is returned to an atmospheric pressure environment so that the die **40** is held in the holding space **21** (see FIG. **3**) which is formed between the base member **30** and the cover member.

Incidentally, the electrode pads **51** of the die **50** and the bumps **324** of the base film **32** are not fastened by solder etc. In the present embodiment, the space between the base member **30** and the cover member **40** is a negative pressure compared with atmospheric pressure, so the die **50** is pressed by the base film **32** and the cover film **42** and the electrode pads **41** of the die **50** and the bumps **324** of the base film **32** contact each other.

Note that, as shown in FIG. **3**, the base member **30** and the cover member **40** may also be fastened to each other at a bonded part **325** so as to prevent positional deviation and to improve the seal. As the binder **326** which forms this bonded part **325** (see FIG. **2** and FIG. **4** to FIG. **6**), for example, a UV curing type binder etc. may be illustrated. This binder **326** is coated in advance on the base member **30** at positions corresponding to the outer periphery of the cover member **40**, the base member **30** is covered with the cover member **40**, then UV rays are irradiated to cure that binder whereby the bonded part **325** is formed.

Further, when the die **50** is relatively thick, conversely from the configuration which is shown in FIG. **3**, the base member **30** and the cover member **40** may be superposed so that the rigid board **31** and the rigid board **41** directly contact each other.

Further, in the present embodiment, as explained later, the pushing mechanism **13** is used to push the base film **32**, so the space between the base member **30** and the cover member **40** need not be reduced in pressure.

Next, the configuration of the electronic device test apparatus **10**, which is used for testing (FIG. **1**, step S**30**) of the die **50** which has been provisionally packaged in the test carrier **20**, will be explained while referring to FIG. **7** to FIG. **12**. Note that, the configuration of the electronic device test apparatus **10** which is explained below is only one example. The invention is not particularly limited to this.

FIG. **7** is a cross-sectional view which shows the configuration of an electronic device test apparatus in the present embodiment, FIG. **8** is a cross-sectional view which shows the configuration of the pushing mechanism in the present embodiment, FIG. **9** and FIG. **10** are cross-sectional views which show modifications of the pushing mechanism in the present embodiment, FIG. **11** is a cross-sectional view which shows a base film of a test carrier which is pushed by the pushing mechanism which is shown in FIG. **8**, and FIG. **12** is a cross-sectional view which shows a modification of an electronic device test apparatus in the present embodiment.

The electronic device test apparatus **10** in the present embodiment, as shown in FIG. **7**, comprises a socket **11**, board **14**, test circuit **15**, and temperature regulating head **16**. Further, the socket **11** has: a pocket **12** in which the test carrier **20** is to be placed; and a pushing mechanism **13** which pushes the base film **32** of the test carrier **20**.

The pocket **12** has a recess **121** which can accommodate the test carrier **20**. At the outer circumferential part of this recess **121**, a stopper **122** which has a seal member **123** at the top is provided extending along the entire circumference. As the seal member **123**, for example, a rubber packing etc. can be used. When the outer periphery of the test carrier **20** abuts against the seal member **123**, the recess **121** is sealed tight.

The pushing mechanism **13**, as shown in FIG. **7**, is provided on a bottom surface **121***a* of the recess **121** of the pocket **12** and is arranged at the approximate center of the inside of that recess **121**. This pushing mechanism **13** is designed to be able to abut against the base film **32** when the test carrier **20** is placed inside of the pocket **12**. In the present embodiment, the pushing mechanism **13** faces the die **50** as a whole through the base film **32**, but the invention is not partially limited to this. It is sufficient that the pushing mechanism **13** faces the die **50** through the base film **32** so as to include at least all of the electrode pads **51** on the die **50**.

This pushing mechanism **13**, as shown in FIG. **8**, comprises: a rubber member **131** which abuts against the bottom surface of the base film **32**; a flat plate support member **137** which supports the rubber member **131**; and a coil spring **138** which is interposed between the support member **137** and the bottom surface **121***a* of the pocket **121**. Note that, instead of the coil spring **138**, a rubber or other elastic member, a motor with a ball screw mechanism, a cylinder, etc. may also be interposed between the support member **137** and the bottom surface of the pocket **121**. Alternatively, the support member **137** and the coil spring **138** may be omitted and the rubber member **131** may be directly fastened to the bottom surface **121***a* of the pocket **121**.

The rubber member **131** has two rubber layers **132**, **133**, The first rubber layer **132** is laid on the support member **137** and, for example, is composed of silicone rubber with a Shore A hardness of 50 degrees. On the other hand, the second rubber layer **133** is laid on the first rubber layer **132** and, for example, is composed of silicone rubber with a Shore A hardness of 5 degrees.

That is, in the present embodiment, the second rubber layer **133** has a Young's modulus which is relatively smaller than the Young's modulus of the first rubber layer **132**. Note that, the elastic materials which form the first and the second rubber layers **132**, **133** are not particularly limited to this. It is sufficient that the second rubber layer **133** be softer than the first rubber layer **132**. Further, if the layer becomes softer with distance to the test carrier **20** (in proportion to being closer to the test carrier), the number of rubber layers which form the rubber member **131** is not particularly limited. The first elastic layer **152** in the present embodiment is equivalent to one example of the first elastic member in the present invention, while the second elastic member **153** in the present embodiment is equivalent to one example of the second elastic member in the present invention.

The second rubber layer **133** has a top surface **133***a* which contacts the bottom surface of that base film **32** when the pushing mechanism **13** pushes the base film **32** of the test carrier **20**. This top surface **133***a*, as shown in FIG. **8**, has a projecting shape which becomes successively higher with distance to the center of that top surface **133***a* (in proportion to being closer to the center). For this reason, when the pushing mechanism **13** contacts the base film **32**, the second rubber layer **133** as a whole can be made to evenly contact the base film **32**.

Note that, the configuration of the pushing mechanism is not particularly limited. For example, a pushing mechanism such as shown in FIG. **9** or FIG. **10** can also be used.

The rubber member **134** of the pushing mechanism **13**B which is shown in FIG. **9** is configured from a single rubber layer which becomes gradually more flexible with distance from the support member **137** (in proportion to being further upward from the support member). In this example as well, the top surface **134***a* of the rubber member **134** has a projecting shape which becomes gradually higher with distance to the center of that top surface **134***a* (in proportion to being closer to the center).

On the other hand, the pushing mechanism **13**C which is shown in FIG. **10** comprises, instead of the rubber member **131**, a bag member **135** which is provided on the support member **137**. This bag member **135** is, for example, composed of silicone rubber or other resin material which is flexible and has elasticity. The internal space **135***a* holds a gas or liquid fluid **136** inside of it.

As a specific example of a fluid **136**, for example, silicone grease or air etc. can be mentioned. Note that, this fluid **136** may be filled completely in the internal space **135***a* of the bag member **135**, but an amount of fluid **136** less than complete may also be filled in the internal space **135***a*.

The above explained pushing mechanisms **15**, **15**B, or **15**C is equivalent to one example of the first pusher in the present invention.

Returning to FIG. **7**, the pocket **12** is mounted on the board **14**. At the bottom surface of the pocket **12**, a suction port **124** is opened. This suction port **124** is connected to a vacuum pump **17** through a communication path **141** which is formed at the inside of the board **14**.

Further, for example pogo pins or other contactors **125** are arranged inside of the recess **121** so as to correspond to the external terminals **312** of the test carrier **20**. The contactors **125** are electrically connected through interconnect patterns **142**, which are formed inside of the board **14**, to a test circuit (tester chip) **15** which is mounted on the back surface of the board **14**. Note that, the test circuit **15** may also be mounted on the top surface of board **14**. In this case, the test circuit **15** is arranged at a side of the pocket **12**.

The tester circuit **15** in the present embodiment is a chip which has the function of testing the electronic circuits which are built in the die **50**, that is, a one-chip tester which is provided with the functions of a conventional tester. Note that, the one-chip type of tester circuit **15** is just one example. For example, it is also possible to use a MCM (Multi-Chip Module) etc. to form the tester circuit or use a conventional tester instead of a tester circuit **15**. The one-chip type of test circuit, MCM test circuit, or conventional tester in the present embodiment is equivalent to examples of the test circuit in the present invention.

The temperature regulating head **16**, as shown in FIG. **7**, has a block **161** which has an abutting surface **162** which abuts against the cover film **42** of the cover member **40** of the test carrier **20**. The block **161** has a temperature sensor **163** and a heater **164** embedded in it. A flow path **165** through which a coolant can flow is formed in the block **161**. This flow path **165** is connected to a not shown chiller.

The block **161** of this temperature regulating head **16** can approach/move away from the test carrier **20** placed in the pocket **12** by a not particularly shown motor with a ball screw mechanism, cylinder, etc. In the state where the abutting face **162** of the block **161** of this temperature regulating head **16** contacts the cover film **42** of the test carrier **20**, the temperature sensor **163** measures the temperature of the die **50** during the test and the measurement results are used as the basis to control the temperature of the die **50** by the heater **164** and the coolant inside the flow path **165**. Note that, the temperature regulating head **14** in embodiment is equivalent to one example of the second pusher in the present invention.

In the present embodiment, when a robot arm or pick-and-place apparatus or other handling apparatus (not shown) is used to place the test carrier **20** in a pocket **12**, the base member **30** of that test carrier **20** and the seal member **132** of the pocket **12** are used to seal the recess **121**. In this state, when operating the vacuum pump **17** to reduce the pressure inside of the recess **121**, the test carrier **20** is pulled toward the inside of the pocket **12** whereby the contactor **125** and the external terminals **312** contact each other.

Further, when the temperature regulating head **16** approaches and abuts against test carrier **20**, the heater **164** and the coolant which flows through the flow path **165** are used to control the temperature of the die **50**. At the same time as this, the rubber member **131** of the pushing mechanism **13** contacts and pushes against the bottom surface of the base film **32** of the test carrier **20**.

In this pushing action of the rubber member **131**, as shown in FIG. **11**, first, the soft second rubber layer **133** deforms to follow the portion **32***b* surrounding the bump **324** in the base film **32** (below, simply referred to as the "bump-surrounding portion **32***b*") and pushes and extends the bump-surrounding portion **32***b* of the base film **32** around the bumps **324**. Note that, the bump-surrounding portion **32***b* in the present embodiment is equivalent to "the portion of the first member surrounding the internal terminal" in the present invention.

At this time, the top surface **133***a* of the second rubber layer **133** has a projecting shape which becomes gradually higher with distance to the center, so the second rubber layer **133** as a whole can be made to evenly contact the base film **32**.

Further, when the second rubber layer **133** deforms and the bump-surrounding portion **32***b* is given sufficient tension, the first rubber layer **132** harder than the second rubber layer **133** pushes the portion **32***a* where the bumps **324** are formed in the base film **32** (below, simply referred to as the "bump-forming portion **32***a*") toward the electrode pads **51** of the die **50** whereby the bumps **324** and the electrode pads **51** contact each other. In this state, the test circuit **15** sends and receives

test signals through the test carrier **20** with the die **50** so as to test the electronic circuit which is built into the die **50**. Note that, the bump-forming portion **32***a* in the present embodiment is equivalent to the "the portion of the first member where the internal terminal is formed" in the present invention.

Note that, as shown in FIG. **12**, instead of the vacuum pump **17**, the pushing head **18** may also be used to directly push the rigid board **51** of the cover member **4** of the test carrier **20** from above so as to make the contactors **125** contact the external terminals **312** of the test carrier **20**. This pushing head **18** can, for example, approach/move away from the test carrier **20** by a not particularly shown motor with a ball screw mechanism, cylinder, etc. Note that, the vacuum pump **17** or the pushing head **18** in the present embodiment is equivalent to one example of the contacting device in the present invention.

As explained above, in the present embodiment, a pushing mechanism **13** which has two rubber layers **132**, **133** differing in Young's modulus is used to push not only the bump-forming portions **32***a* of the base film **32**, but also the bump-surrounding portions **32***b*. For this reason, it is possible to push and extend the base film **32** and eliminate waviness of the base film **32** while making the bumps **324** of the test carrier **20** contact the electrode pads **51** of the die **50**, so it is possible to suppress poor contact of the bumps **324** and electrode pads **51**.

Further, in the present embodiment, the first rubber layer **132** and the second rubber layer **133** can be used to absorb warping of the die **50** and variation in height of the bumps **324**.

Note that, the above explained embodiment was described to facilitate understanding of the present invention and was not described for limiting the present invention. Therefore, the elements which were disclosed in the embodiment include all design changes and equivalents falling under the technical scope of the present invention.

For example, a configuration reversing the positional relationship between the pushing mechanism **13** and the temperature regulating head **16** also falls under the technical scope of the present invention. That is, in FIG. **7**, the pushing mechanism **13** may also be made to approach the test carrier **20** from above and provide a temperature regulating head **16** inside the pocket **12** of the socket **11**.

REFERENCE SIGNS LIST

10 . . . electronic device test apparatus
11 . . . socket
12 . . . pocket
121 . . . recess
125 . . . contactor
13, **13**B, **13**C . . . pushing mechanism
131 . . . rubber member
132 . . . first rubber layer
133 . . . second rubber layer
133*a* . . . top surface
134 . . . rubber member
134*a* . . . top surface
135 . . . bag member
135*a* . . . internal space
136 . . . fluid
14 . . . board
15 . . . test circuit
16 . . . temperature regulating head
20 . . . test carrier
30 . . . base member
31 . . . base frame
312 . . . external terminals
32 . . . base film
32*a* . . . hump-forming portion
32*b* . . . bump-surrounding portion
324 . . . bump
40 . . . cover member

What is claimed is:

1. A socket to which a test carrier is electrically connected, the test carrier including: a film-shaped first member on which at least one internal terminal, which contacts at least one electrode of an electronic device, is provided; and at least one external terminal which is electrically connected to the internal terminal,

the socket comprising:

at least one contactor which contacts the external terminal; and

a first pusher which pushes a portion of the first member where the internal terminal is provided and a portion of the first member surrounding the internal terminal, wherein

the first pusher comprises:

a bag member which has a sealed space within the bag member; and

a fluid which is housed in the sealed space.

2. An electronic device test apparatus which tests an electronic device which is temporarily mounted to the test carrier,

the electronic device test apparatus comprising:

the socket as set forth in claim **1**;

a contacting device which brings the external terminal and the contactor into contact; and

a second pusher which pushes the test carrier from a direction opposite to the pushing direction of the first pusher.

3. The electronic device test apparatus as set forth in claim **2**, wherein

the second pusher pushes a second member of the test carrier which holds the electronic device with a first member.

4. The electronic device test apparatus as set forth in claim **2**, wherein

the electronic device is a die which is diced from a semiconductor wafer.

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